(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 383 409 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **11.05.94** (51) Int. Cl.5: **B32B 5/28**, B29C 67/12

(21) Application number: **90200360.7**

(22) Date of filing: **16.02.90**

(54) **Sandwich panel material, and a method of providing a local reinforcement in a sandwich structure.**

(30) Priority: **17.02.89 NL 8900398**

(43) Date of publication of application:
22.08.90 Bulletin 90/34

(45) Publication of the grant of the patent:
11.05.94 Bulletin 94/19

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI NL SE

(56) References cited:
FR-A- 2 591 147

PATENT ABSTRACTS OF JAPAN, vol. 7, no. 199 (M-240)[1344], 3rd September 1983, page 97 M 240; & JP-A-58 99 531

(73) Proprietor: **Airex AG**

CH-5643 Sins(CH)

(72) Inventor: **Brambach, Johan Arie**
Dorpsstraat 102
NL-2451 AS Leimuiden(NL)

(74) Representative: **Smulders, Theodorus A.H.J., Ir. et al**
Vereenigde Octrooibureaux
Nieuwe Parklaan 97
NL-2587 BN 's-Gravenhage (NL)

EP 0 383 409 B1

Description

This invention relates to a sheet-like sandwich material provided with a local reinforcement and to a method of providing a local reinforcement in a sheet-like material, such as a sandwich structure. More specifically, the invention relates to a thermoplastic sandwich structure and to a method of providing a reinforcement in a thermoplastic sandwich structure.

Sheet-like materials, such as sandwich structures, find wide application in areas where materials are used which must combine a high strength or rigidity with a light weight. This is the case, for example, in air, space, and transport applications.

Sandwich structures generally consist of a core material that is light in weight, with a top layer, often reinforced, on both surfaces thereof. Owing to the excellent bonding between the top layers and the core material, proper stiffness is obtained. The other properties of the material are partly determined by the nature of the various materials.

Known sandwich structures are based on a core material having a honeycomb structure. Another type of sandwich material is described in European Patent Applications Nos. 264 495 and 268 148, which are incorporated herein by reference. This material is fully thermoplastic and consists of a core material including, among other components, a thermoplastic foam, and two top layers consisting of a fibre-reinforced synthetic plastics material, such as polycarbonate or polyether imide.

In European Patent Application No. 88202345.0, which is incorporated herein by reference, a flame-retarding sheet material is described which is also thermoplastic.

European Patent Application No. 345 855, published on December 13, 1989, which is incorporated herein by reference, relates to a non-foamed film which can be used for the manufacture of a thermoplastic sandwich material.

In the application of a sandwich structure, it may sometimes be desirable that local reinforcements be provided in the material. Sandwich structures are often in the form of a plate, for example, a wall panel, to which various objects must be secured. As this may locally involve rather considerable forces, it is necessary to provide local reinforcement to enable auxiliary means to be secured. In the known systems this is effected by making a hole in one of the top layers of the sandwich structure. Subsequently, core material is removed, whereafter a solid filler is substituted for the core removed. Conventional fillers are based on thermosetting two-component systems. This operation is highly labour-intensive, the result of which is that the cost of labour involved in processing sandwich structures is high, and processing takes a long time, too.

It is one object of the present invention to provide a sheet-like sandwich material provided with a local reinforcement,comprising a core material sandwiched between two reinforced top layers, which core material is a thermoplastic, foamed core material or a core material having a honeycomb structure, and which top layers consist of a thermoplastic synthetic plastics material reinforced with fibres, preferably in the form of a woven fabric, a knitted fabric, a fibrous web, or unidirectionally applied fibres, and at least one local reinforcement.

It is another object of the invention to provide a method of providing a local reinforcement in the core of a sandwich structure. The sheet-like material and the method according to the invention do not have the disadvantages inherent in the known methods of providing local reinforcements in sheet materials.

The sheet-like sandwich material according to the invention accordingly comprises a core material sandwiched between two reinforced top layers and at least one local reinforcement consisting of an amount of plastic material injected under pressure into the core material through one of the top layers, and which plastic material has hardened after injection.

The method according to the invention relates to the provision of a local reinforcement in a sheet-like material comprising a core material sandwiched between two reinforced top layers, and which comprises injecting an amount of plastic material under pressure through one of the top layers into the core material, which plastic material hardens after injection.

Surprisingly it has been found that, according to the invention, a sheet-like sandwich material is provided which has good possibilities for the application of auxiliary means, such as fixtures, hinges, brackets, lamp holders, and the like, while the local reinforcement can be provided in the sandwich material rapidly, efficiently and reliably.

According to a preferred embodiment of the method according to the invention, the plastic material replaces and/or melts the core material at the place where it is injected. Preferably, the amount of the material to be injected and its temperature are adjusted in such a manner that a portion of the foam melts away at the injection site. As, during the injection, the required melting heat provides for cooling of the plastic material, a hard layer is formed on the outside of the injection, as a result of which pressure build-up is possible, so that a local reinforcement is formed.

It is noted that US Patent 3,492,381 discloses a method for providing a reinforcement in chipboard

or other porous material by injecting a bonding agent, such as a urea-based bonding agent. According to this method, the core material is pressed away, so that there is the risk that the sheet material is damaged. Surprisingly it has been found that this risk does not exist in the application of the present invention, for one thing owing to the effect described above with regard to the hardening of the outside of the material injected.

A preferred plastic material is a thermoplastic synthetic resin or mixture of thermoplastic synthetic resins with a softening temperature of at least 50°C. Such plastics may, inter alia, be selected from the group consisting of polystyrene, styrene polymers, acrylate and/or methacrylate polymers, polyolefins, polyesters, such as PET and PBT, polycarbonate, polyether imide, polyamide, polysulphone, polyether sulphone, polyether ketone, polyether ether ketone,polyether ketone ketone, polyphenylene oxide, polyphenylene sulphide, and mixtures of two or more of these synthetic plastics materials. Such materials not only have the advantage of being capable of being injected into the core with facility, but contribute towards improving the pressure resistance of the sheet material.

If so desired, these synthetic plastics materials may contain a quantity of fibres, which are injected along with it. The fibres are preferably selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres and carbon fibres.

It is also possible to incorporate a quantity of blowing agent into the synthetic plastics material to be injected, which blowing agent forms a foam of the synthetic plastics material injected during and after the injection. Naturally, it is then of importance that the quantity of foaming agent should be such that the density of the reinforcement is greater than the density of the surrounding core material, or that the pressure resistance of the foam formed should be greater than the pressure resistance of the core of the sheet-like sandwich material.

It is noted that it also possible to inject two plastic materials simultaneously, or one after the other. In this connection one may in particular be thinking of such an injection of two different materials that one material forms the core of the injection and the other material forms a kind of skin around it. This can be achieved both by the simultaneous injection of two or more materials, and by the consecutive injection of such two or more materials.

The sheet-like material (sandwich structure) to be reinforced preferably consists of a thermoplastic, foamed core material and two top layers consisting of a thermoplastic synthetic resin reinforced with a woven fabric, a knitted fabric, a fibrous web, or unidirectionally applied fibres. Such a material is described, for example, in European Patent Applications Nos. 264 495 and 268 148, referred to hereinbefore.

The sheet material (sandwich structure) to be reinforced can be made by laminating the components to be used, foam core and top layers, possibly with bonding layers between them, and with or without the use of softening agents, and subsequently bonding the layers together by applying heat and pressure. It is also possible for the foamed core material to be generated in situ by using an expandable material which foams and bonds to the top layers when heated. One example of such an expandable material is described in European Patent Application No. 345 855, which is incorporated herein by reference. This material can be used for both the core material and an additional bonding layer.

The materials from which the sheet-like material may be made are also described in the European patent applications referred to. More specifically, the thermoplastic foamed core material is a polyether imide foam, a polycarbonate foam, a polymethacrylamide foam, a polyester foam, such as a foam of PET or PBT, a polyether sulphone foam, a polyether ketone foam, a polyether ether ketone foam, a polyether ketone ketone foam, a polyphenylene oxide foam, a polyphenylene sulphide foam, or foam materials made of mixtures of thermoplastic synthetic resins containing at least one of the thermoplastic synthetic resins referred to. It is also possible to use a combination of two or more foams for the core material.

If desired, fibres may be incorporated in the foam material. Such fibres may be selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres, carbon fibres, and combinations of two or more of these fibres.

Also, to improve the mechanical properties of the material, it may be preferable to incorporate liquid crystalline materials in the foam. Specifically if the foam is generated in situ during the manufacture of the sandwich material, the use of such materials has been found to give good results.

When the above foam materials are used, in combination with the thermoplastic synthetic resins, to be specified hereinafter for the top layer and the reinforcement, an optimum construction of the reinforcement and a maximum strength of the total construction and of the reinforced points are obtained.

The top layers consist of fibre-reinforced synthetic plastics, more particularly of a thermoplastic synthetic resin reinforced with a woven fabric, a knitted fabric, a fibrous web, or unidirectionally

applied fibres.

The thermoplastic synthetic resin, the matrix material of the top layers, is generally a synthetic plastics or a mixture of synthetic plastics having a high softening point, for example polyester, such as PET and PBT, polycarbonate, polyether imide, polyamide, polysulphone, polyether sulphone, polyether ketone, polyether ether ketone, polyether ketone ketone, polyphenylene oxide, polyphenylene sulphide, or a mixture of two or more of these plastics. It is also possible to use two or more different top layers or materials for the top layers.

In the top layer, these synthetic plastics are preferably reinforced with glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres, and carbon fibres. The nature of the fibre reinforcement in the top layer has no substantial effect on the conditions for the injection of the thermoplastic synthetic resin into the core, but the degree of reinforcement may have an effect on it. In fact, according as the density of the fibre reinforcement in the skin is higher, the more pressure will have to be exercised for injection through the top layer. However, these pressure variations always range within conventional injection moulding pressures. In the case of very high densities of the fibres in the skin it may in certain cases be desirable or advantageous to drill a small hole into the skin. This, however, is not comparable at all to drilling a large hole and removing the core as has hitherto been conventional.

The method according to the invention is quite simple to perform, and it is possible to use existing equipment. In fact, when an injection moulding machine is used, one only has to move the nozzle (die piece) thereof to the place to be reinforced and to inject a metered dose of molten thermoplastic synthetic resin. Owing to the force of the injection, the plastic material is injected through the top layer and finds its way into the core. Depending on the conditions and materials used, this will take place through displacement and/or fusion. Especially when used in thermoplastic sandwich structures, this has great advantages, as the heat of the molten thermoplastic synthetic resin being injected causes the foam to melt during its injection into the core of the sandwich structure. It has been found that, in this manner, there is also obtained a good bonding of the local reinforcement in the core to the top layers. It can also be accomplished, through a proper choice of materials, that good bonding is obtained between the reinforcement and the rest of the core material. In known methods of reinforcing sandwich structures, bonding to the top layers, in particular, may leave much to be desired.

According to a different embodiment of the method according to the invention, the plastic material is directly injected into the core, which is also attended by displacement and/or fusion.

For carrying out the method according to the invention, conventional injection moulding machines can be used. To the extent necessary, adaptation may be desirable for the nozzle (die piece) to be taken to the proper place for injection. It is also possible, however, to use modified equipment, for example, injection moulding machines enabling injection of the plastic material direct into the core material. For this purpose, for example, equipment may be used provided with a kind of "needle-shaped" injection nozzle, which is inserted through the top layer into the core. It is also possible to use nozzles having more than one aperture, so that more than plastic material may be used.

When relatively high injection pressures are used, it may be desirable for the sheet-like material to be supported at the back, i.e. the side where no injection takes place, to prevent the plastic material from being forced through the sheet.

The thermoplastic synthetic resin is dosed, depending on the nature of the material, the desired reinforcement in the core, and the thickness of the sandwich construction. It has been found, however, that the quantity is not very critical. For a sandwich structure 8 mm thick, a dosage of 0.5-20 ml plastic material can be used. A good local reinforcement is then obtained.

The invention is also applicable to other sandwich structures than those described in the above European patent applications. In particular, the invention is also suitable for providing local reinforcement in sandwich structures based on a core material having a honeycomb structure.

The method according to the invention is applicable to flat sheet-like materials, but also to sheet-like articles already formed. An important point in this connection is that, in principle, the reinforcement does not affect the further processability and deformability of the sheet material. This is of great importance for the thermoplastic sandwich structures of the above European patent applications, whose major advantage is in fact that they continue to be thermoplastically deformable. The methods of manufacture and processing described in the European patent applications referred to in the introductory part of this specification can be applied without any problems to the materials according to the present invention, both before and after the provision of the local reinforcement.

The locally reinforced sheet materials can be provided with auxiliary means at the position of the reinforcement. Examples of such means that are threaded bushings, hinges, pivots, and the like. When threaded bushings or comparable auxiliary means are mounted, it may have advantages for

them to be installed together with the reinforcement during injection.

A major advantage of the invention is that the pressure resistance of the material according to the invention is greatly improved. This makes it possible for auxiliary means to be provided on its surface by means of injection moulding. With conventional materials this was impossible, because the pressure resistance of the sheet material was insufficient for the purpose.

Alternatively, auxiliary means can be provided prior to, or after, the provision of the local reinforcement. Accordingly, there is the possibility for such auxiliary means to be provided by injection moulding. It is possible to do this in one operation, together with the provision of the reinforcement. It is also possible, however, for these auxiliary means to be provided in one or more supplementary operations. One suitable method is providing such an auxiliary means, such as a fixing aid, a part, or a product, at the already reinforced place by injection moulding. Naturally, it is also possible to do this by using conventional attachment techniques, such as screwing, cementing, and the like.

The invention is illustrated in and by the following example, but is not so limited.

Example

A sandwich panel consisting of a foam core of polyether imide with a specific gravity of 90 km/m^3 and two top layers of glass fibre web (107 g/m^2), impregnated with polyether imide (50%), and 5 mm thick, was provided with a reinforcement. This was effected by injecting molten polyether imide by means of an injection moulding nozzle (die piece) through the top layer. The sandwich panel was supported with a metal plate on one side, while the nozzle was held in contact with the surface of the top layer on the other side. The nozzle was provided with an area extension. Owing to the force of the injection, the material was injected into the core with an injection period of 2 seconds. The resulting, reinforced surface had a diameter of 30 mm. The compressive strength at the reinforcement was 120 N/mm^2. The compressive strength of the panel itself was 3 N/mm^2.

Claims

1. A sheet-like sandwich material provided with a local reinforcement, comprising a core material sandwiched between two reinforced top layers, which core material is a thermoplastic, foamed core material or a core material having a honeycomb structure, and which top layers consist of a thermoplastic synthetic plastics material reinforced with fibres, preferably in the form of a woven fabric, a knitted fabric, a fibrous web, or unidirectionally applied fibres, and at least one local reinforcement consisting of an amount of plastic material injected under pressure into the core material through one of the top layers, and which plastic material has hardened after injection.

2. A sheet-like sandwich material according to claim 1, in which the plastic material has replaced and/or molten the core material at the place where it is injected.

3. A sheet-like material according to claim 1 or 2, wherein the plastic material is a thermoplastic synthetic resin with a softening temperature of at least 50 °C.

4. A sheet-like sandwich material according to claims 1-3, wherein the thermoplastic foamed core material is selected from polyether imide foam, polycarbonate foam, polymethacrylamide foam, polyester foam, such as a foam of PET or PBT, polyether sulphone foam, polyether ketone foam, polyether ether ketone foam, polyether ketone ketone foam, a polyphenylene oxide foam, a polyphenylene sulphide foam, or foam materials made of mixtures of thermoplastic synthetic resins containing at least one of the thermoplastic synthetic resins referred to.

5. A sheet-like sandwich material according to claims 1-4, wherein the thermoplastic foamed core material contains fibres.

6. A sheet-like sandwich material according to claim 5, wherein said fibres have been selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres, and carbon fibres.

7. A sheet-like sandwich material according to claims 1-6, in which the thermoplastic foamed core material contains liquid crystalline materials.

8. A sheet-like sandwich material according to claims 1-7, wherein the thermoplastic synthetic resin of the top layer, is a material selected from the group consisting of polyester, such as PET and PBT, polycarbonate, polyether imide, polyamide, polysulphone, polyether sulphone, polyether ketone, polyether ether ketone, polyether ketone ketone, polyphenylene oxide, polyphenylene sulphide, and mixtures of two or more of these plastics.

9. A sheet-like sandwich material according to claims 1-8, in which the top layer is reinforced with a material selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres, and carbon fibres.

10. A sheet-like sandwich material according to claims 3-9, wherein the thermoplastic synthetic resin injected is a material selected from the group consisting of polystyrene, styrene polymers, acrylate and/or methacrylate polymers, polyolefins, polyesters, such as PET and PBT, polycarbonate, polyether imide, polyamide, polysulphone, polyether sulphone, polyether ketone, polyether ether ketone, polyether ketone ketone, polyphenylene oxide, polyphenylene sulphide, and mixtures of two or more of these synthetic plastics materials.

11. A sheet-like sandwich material according to claims 3-10, in which the thermoplastic synthetic resin injected contains fibrs.

12. A sheet-like sandwich material according to claim 11, wherein the fibres have been selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres and carbon fibres.

13. A sheet-like sandwich material according to claims 1-12, and further comprising auxiliary means mounted in the reinforcement.

14. A sheet-like sandwich material according to claim 13, wherein the auxiliary means has been mounted during the injection of the plastic material.

15. A sheet-like sandwich material according to claims 1-14, wherein an auxiliary means has been mounted at the reinforcement place after the reinforcement has been provided.

16. A sheet-like sandwich material according to claims 13-15, wherein the auxiliary means is a fastening means, a component part, or a product.

17. A sheet-like sandwich material according to claims 13-16, wherein the auxiliary means is provided and installed at the reinforcement place by means of injection moulding.

18. A method of providing a local reinforcement in a sheet-like material comprising a core material sandwiched between two reinforced top layers, which core material is a thermoplastic, foamed core material or a core material having a honeycomb structure, and which top layers consist of a thermoplastic synthetic plastics material reinforced with fibres, preferably in the form of a woven fabric, a knitted fabric, a fibrous web, or unidirectionally applied fibres, which comprises injecting an amount of plastic material under pressure through one of the top layers into the core material, which plastic material hardens after injection.

19. A method according to claim 18, in which the plastic material replaces and/or melts the core material at the place where it is injected.

20. A method as claimed in claim 18 or 19, in which the plastic material used is a thermoplastic synthetic resin with a softening temperature of at least 50 °C.

21. A method as claimed in claims 18-20, in which the plastic material is injected under pressure through the reinforced top layer into the core by means of an injection moulding machine.

22. A method as claimed in claims 18-21, in which said thermoplastic foamed core material is a material selected from the group consisting of polyether imide foam, polycarbonate foam, polymethacrylamide foam, polyester foam, such as a foam of PET or PBT, polyether sulphone foam, polyether ketone foam, polyether ether ketone foam, polyether ketone ketone foam, polyphenylene oxide foam, polyphenylene sulphide foam, and a foam material made of mixtures of thermoplastic synthetic resins containing at least one of the thermoplastic synthetic resins referred to.

23. A method as claimed in claims 18-22, in which the thermoplastic, foamed core material contains fibres.

24. A material as claimed in claim 23, in which the fibres are selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres, and carbon fibres.

25. A method as claimed in claims 18-24, wherein the thermoplastic, foamed core material contains liquid crystalline materials.

26. A method as claimed in claims 18-25, wherein the thermoplastic synthetic resin of the top layer is selected from the group consisting of polyester, such as PET and PBT, polycar-

bonate, polyether imide, polyamide, polysulphone, polyether sulphone, polyether ketone, polyether ether ketone, polyether ketone ketone, polyphenylene oxide, polyphenylene sulphide, and mixtures of two or more of these plastics.

27. A method as claimed in claims 18-26, wherein the material of the reinforcement in the top layer is selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres, and carbon fibres.

28. A method as claimed in claims 20-27, in which the thermoplastic synthetic resin to be injected is selected from the group consisting of polystyrene, styrene polymers, acrylate and/or methacrylate polymers, polyolefins, polyesters, such as PET and PBT, polycarbonate, polyether imide, polyamide, polysulphone, polyether sulphone, polyether ketone, polyether ether ketone, polyether ketone ketone, polyphenylene oxide, polyphenylene sulphide, and mixtures of two or more of these synthetic plastics materials.

29. A method as claimed in claims 20-28, in which the synthetic plastics material to be injected contains fibres.

30. A method as claimed in claim 29, in which the fibres are selected from the group consisting of glass fibres, polyamide fibres, such as aramide fibres, polyethylene fibres, polyester fibres and carbon fibres.

31. A method as claimed in claims 18-30, wherein an auxiliary means is mounted in the reinforcement.

32. A method as claimed in claim 31, wherein the auxiliary means is mounted during the injection of the plastic material.

33. A method as claimed in claims 18-32, wherein an auxiliary means is mounted at the reinforced place after the reinforcement has been provided.

34. A method as claimed in claims 30-33, wherein the auxiliary means is provided and installed at the reinforced place by means of injection moulding.

35. A method as claimed in claims 30-34, wherein the auxiliary means is a fastening means, a component part, or a product.

Patentansprüche

1. Plattenartiges Verbundmaterial ("Sandwich-Material") mit lokaler Verstärkung, welches umfaßt: ein Kernmaterial, das sich Zwischen zwei verstärkten Deckschichten befindet, wobei das Kernmaterial ein thermoplastisches, geschäumtes Kernmaterial oder ein Kernmaterial mit einer wabenartigen Struktur ist, und wobei die Deckschichten aus einem thermoplastischen synthetischen Kunststoffmaterial bestehen, das mit Fasern verstärkt ist, vorzugweise in Form eines Gewebes, eines gestrickten Materials, einer Faserbahn oder unidirektional angewendeter Fasern, und wobei wenigstens eine lokale Verstärkung aus einer unter Druck in das Kernmaterial durch eine der Deckschichten hindurch eingespritzte Menge an Kunststoffmaterial besteht, wobei das Kunststoffmaterial nach dem Einspritzen hart wurde.

2. Plattenartiges Verbundmaterial nach Anspruch 1, worin das Kunststoffmaterial an der eingespritzten Stelle das Kernmaterial ersetzt/und oder geschmolzen hat.

3. Plattenartiges Material nach Anspruch 1 oder 2, worin das Kunststoffmaterial ein thermoplastisches synthetisches Harz mit einer Erweichungstemperatur von wenigstens 50 ° C ist.

4. Plattenartiges Verbundmaterial nach Anspruch 1 bis 3, worin das thermoplastische geschäumte Kernmaterial ausgewählt wird aus: Polyetherimid-Schaum, Polycarbonat-Schaum, Polymethacrylamid-Schaum, Polyester-Schaum wie PET- oder PBT-Schaum, Polyethersulfon-Schaum, Polyetherketon-Schaum, Polyetheretherketon-Schaum, Polyetherketonketon-Schaum, ein Polyphenylenoxid-Schaum, ein Polyphenylensulfid-Schaum oder Schaumstoffen, hergestellt aus Mischungen thermoplastischer synthetischer Harze, die wenigstens eines der genannten thermoplastischen synthetischen Harte enthalten.

5. Plattenartiges Verbundmaterial nach Anspruch 1 bis 4, worin das thermoplastische geschäumte Kernmaterial Fasern enthält.

6. Plattenartiges Verbundmaterial nach Anspruch 5, worin die genannten Fasern aus der aus Glasfasern, Polyamidfasern wie Aramidfasern, Polyethylenfasern, Polyesterfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt wurden.

7. Plattenartiges Verbundmaterial nach Anspruch 1 bis 6, worin das thermoplastische geschäumte Kernmaterial flüssige kristalline Materialien enthält.

8. Plattenartiges Verbundmaterial nach Anspruch 1 bis 7, worin das thermoplastische synthetische Harz der Deckschicht ein Material ist, das aus der Gruppe ausgewählt wurde: Polyester wie PET und PBT, Polycarbonat, Polyetherimid, Polyamid, Polysulfon, Polyethersulfon, Polyetherketon, Polyetheretherketon, Polyetherketonketon, Polyphenylenoxid, Polyphenylensulfid und Mischungen von Zwei oder mehreren dieser Kunststoffe.

9. Plattenartiges Verbundmaterial nach Anspruch 1 bis 8, worin die Deckschicht mit einem Material verstärkt ist, das aus der aus Glasfasern, Polyamidfasern wie Aramidfasern, Polyethylenfasern, Polyesterfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt wurde.

10. Plattenartiges Verbundmaterial nach Anspruch 3 bis 9, worin das eingespritzte thermoplastische synthetische Harz ein Material ist, das aus der Gruppe ausgewählt wurde: Polystyrol, Styrolpolymere, Acrylat- und/oder Methacrylatpolymere, Polyolefine, Polyester wie PET und PBT, Polycarbonat, Polyetherimid, Polyamid, Polysulfon, Polyethersulfon, Polyetherketon, Polyetheretherketon, Polyetherketonketon, Polyphenylenoxid, Polyphenylsulfid und Mischungen von Zwei oder mehreren dieser synthetischen Kunststoffmaterialien.

11. Plattenartiges Verbundmaterial nach Anspruch 3 bis 10, worin das eingespritzte thermoplastische synthetische Harz Fasern enthält.

12. Plattenartiges Verbundmaterial nach Anspruch 11, worin die Fasern aus der aus Glasfasern, Polyamidfasern wie Aramidfasern, Polyethylenfasern, Polyesterfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt wurden.

13. Plattenartiges Verbundmaterial nach Anspruch 1 bis 12, das weiterhin Hilfsmittel enthält, die in der Verstärkung eingebaut wurden.

14. Plattenartiges Verbundmaterial nach Anspruch 13, worin die Hilfsmittel während des Einspritzens des Kunststoffmaterials eingebaut wurden.

15. Plattenartiges Verbundmaterial nach Anspruch 1 bis 14, worin die Hilfsmittel an dem Platz der Verstärkung eingebaut wurden, nachdem das Material mit der Verstärkung versehen wurde.

16. Plattenartiges Verbundmaterial nach Anspruch 13 bis 15, worin das Hilfsmittel ein Befestigungsmittel, ein Einzelteil oder ein Produkt ist.

17. Plattenartiges Verbundmaterial nach Anspruch 13 bis 16, worin das Hilfsmittel an dem Ort der Verstärkung mittels Spritzgießen plaziert und installiert wurde.

18. Verfahren zur Schaffung einer lokalen Verstärkung in einem plattenartigen Verbundmaterial, welches ein Kernmaterial, das sich zwischen zwei Deckschichten befindet, umfaßt, wobei das Kernmaterial ein thermoplastisches, geschäumtes Kernmaterial oder ein Kernmaterial mit Wabenstruktur ist, und wobei die Deckschichten aus einem thermoplastischen synthetischen Kunststoffmaterial, das mit Fasern verstärkt ist, vorzugweise in Form eines Gewebes, eines gestrickten Materials, einer Faserbahn oder unidirektional angewendeter Fasern, bestehen, welches das Einspritzen einer Menge eines Kunststoffmaterials unter Druck durch eine der Deckschichten hindurch in das Kernmaterial umfaßt, wobei das Kunststoffmaterial nach dem Einspritzen hart wurde.

19. Verfahren nach Anspruch 18, worin das Kunststoffmaterial das Kernmaterial and der Stelle, an der es eingespritzt wird, ersetzt und/oder schmilzt.

20. Verfahren nach Anspruch 18 oder 19, worin das verwendete Kunststoffmaterial ein thermoplastisches synthetisches Harz mit einer Erweichungstemperatur von wenigstens 50 ° C ist.

21. Verfahren nach Anspruch 18 bis 20, worin das Kunststoffmaterial unter Druck durch die verstärkte Deckschicht in das Kernmaterial mittels einer Spritzgießvorrichtung eingespsritzt wird.

22. Verfahren nach Anspruch 18 bis 21, worin das genannte thermoplastische geschäumte Kernmaterial ein Material ist, ausgewählt aus der Gruppe: Polyetherimid-Schaum, Polycarbonat-Schaum, Polymethacrylamid-Schaum, Polyester-Schaum wie PET- oder PBT-Schaum, Polyethersulfon-Schaum, Polyetherketon-Schaum, Polyetheretherketon-Schaum, Polyetherketonketon-Schaum, Polyphenylenoxid-Schaum, Polyphenylensulfid-Schaum und Schaummaterialien, hergestellt aus Mischungen thermoplastischer synthetischer Harze, die wenigstens eines der genannten thermoplastischen synthetischen Harze enthalten.

23. Verfahren nach Anspruch 18 bis 22, worin das thermoplastische geschäumte Kernmaterial Fasern enthält.

24. Material nach Anspruch 23, worin die Fasern aus der aus Glasfasern, Polyamidfasern wie Aramidfasern, Polyethylenfasern, Polyesterfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt wurden.

25. Verfahren nach Anspruch 18 bis 24, worin das thermoplastische geschäumte Kernmaterial flüssige kristalline Materialien enthält.

26. Verfahren nach Anspruch 18 bis 25, worin das thermoplastische synthetische Harz der Deckschicht aus der Gruppe ausgewählt wurde: Polyester wie PET und PBT, Polycarbonat, Polyetherimid, Polyamid, Polysulfon, Polyethersulfon, Polyetherketon, Polyetheretherketon, Polyetherketonketon, Polyphenylenoxid, Polyphenylensulfid und Mischungen von zwei oder mehreren dieser Kunststoffe.

27. Verfahren nach Anspruch 18 bis 26, worin das Verstärkungsmaterial in der Deckschicht aus der aus Glasfasern, Polyamidfasern wie Aramidfasern, Polyethylenfasern, Polyesterfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt wird.

28. Verfahren nach Anspruch 20 bis 27, worin das thermoplastische synthetische Harz, das eingespritzt werden soll, aus der Gruppe ausgewählt wird: Polystyrol, Styrolpolymere, Acrylat- und/oder Methacrylatpolymere, Polyolefine, Polyester wie PET und PBT, Polycarbonat, Polyetherimid, Polyamid, Polysulfon, Polyethersulfon, Polyetherketon, Polyetheretherketon, Polyetherketonketon, Polyphenylenoxid, Polyphenylsulfid und Mischungen von zwei oder mehreren dieser synthetischen Kunststoffmaterialien.

29. Verfahren nach Anspruch 20 bis 28, worin das synthetische Kunststoffmaterial, das eingespritzt werden soll, Fasern enthält.

30. Verfahren nach Anspruch 29, worin die Fasern aus der aus Glasfasern, Polyamidfasern wie Aramidfasern, Polyethylenfasern, Polyesterfasern und Kohlenstoff-Fasern bestehenden Gruppe ausgewählt werden.

31. Verfahren nach Anspruch 18 bis 30, worin ein Hilfsmittel in die Verstärkung eingebaut wird.

32. Verfahren nach Anspruch 31, worin das Hilfsmittel während des Einspritzens des Kunststoffmaterials eingebaut wird.

33. Verfahren nach Anspruch 18 bis 32, worin das Hilfsmittel am Ort der Verstärkung eingebaut wird, nachdem das Material mit der Verstärkung versehen wurde.

34. Verfahren nach Anspruch 30 bis 33, worin das Hilfsmittel am Ort der Verstärkung mittels Spritzgießen plaziert und installiert wird.

35. Verfahren nach Anspruch 30 bis 34, worin das Hilfsmittel ein Befestigungsmittel, ein Einzelteil oder ein Produkt ist.

Revendications

1. Matériau sandwich analogue à une feuille muni d'un renforcement local, comprenant un matériau formant âme situé entre deux couches supérieures renforcées, lequel matériau formant âme est un matériau formant âme thermoplastique mis sous forme de mousse ou un matériau formant âme ayant une structure en nid d'abeilles, et lesquelles couches supérieures consistent en une matière plastique synthétique thermoplastique renforcée par des fibres, de préférence sous forme d'une étoffe tissée, d'une étoffe tricotée, d'une nappe fibreuse ou de fibres appliquées de manière unidirectionnelle, et au moins un renforcement local consistant en une quantité de matière plastique injectée sous pression dans le matériau formant âme à travers l'une des couches supérieures, et laquelle matière plastique a durci après l'injection.

2. Matériau sandwich analogue à une feuille selon la revendication 1, dans lequel la matière plastique a remplacé et/ou fait fondre le matériau formant âme à l'endroit où elle est injectée.

3. Matériau analogue à une feuille selon la revendication 1 ou 2, dans lequel la matière plastique est une résine thermoplastique synthétique ayant une température de ramollissement d'au moins 50 °C.

4. Matériau sandwich analogue à une feuille selon les revendications 1 à 3, dans lequel le matériau formant âme thermoplastique mis sous forme de mousse est choisi parmi une mousse de polyétherimide, une mousse de polycarbonate, une mousse de polyméthacrylamide, une mousse de polyester, comme une

mousse de PET ou de PBT, une mousse de polyéthersulfone, une mousse de polyéthercétone, une mousse de polyétheréthercétone, une mousse de polyéthercétonecétone, une mousse de poly(oxyde de phénylène), une mousse de poly(sulfure de phénylène), ou des matériaux en mous se formés de mélanges de résines thermoplastiques synthétiques contenant au moins l'une des résines thermoplastiques synthétiques citées.

5. Matériau sandwich analogue à une feuille selon les revendications 1 à 4, dans lequel le matériau formant âme thermoplastique mis sous forme de mousse contient des fibres.

6. Matériau sandwich analogue à une feuille selon la revendication 5, dans lequel lesdites fibres ont été choisies dans le groupe consistant en les fibres de verre, les fibres de polyamide, comme les fibres d'aramide, les fibres de polyéthylène, les fibres de polyester et les fibres de carbone.

7. Matériau sandwich analogue à une feuille selon les revendications 1 à 6, dans lequel le matériau formant âme thermoplastique mis sous forme de mousse contient des matériaux cristallins liquides.

8. Matériau sandwich analogue à une feuille selon les revendications 1 à 7, dans lequel la résine thermoplastique synthétique de la couche supérieure est une matière choisie dans le groupe consistant en un polyester comme PET et PBT, un polycarbonate, un polyétherimide, un polyamide, une polysulfone, une polyéthersulfone, une polyéthercétone, une polyétheréthercétone, une polyéthercétonecétone, un poly(oxyde de phénylène), un poly(sulfure de phénylène), et des mélanges de deux de ces matières plastiques ou plus.

9. Matériau sandwich analogue à une feuille selon les revendications 1 à 8, dans lequel la couche supérieure est renforcée avec une matière choisie dans le groupe consistant en les fibres de verre, les fibres de polyamide comme les fibres d'aramide, les fibres de polyéthylène, les fibres de polyester et les fibres de carbone.

10. Matériau sandwich analogue à une feuille selon les revendications 3 à 9, dans lequel la résine thermoplastique synthétique injectée est une matière choisie dans le groupe consistant en le polystyrène, les polymères du styrène, les polymères d'acrylate et/ou de méthacrylate, les polyoléfines, les polyesters comme PET et PBT, un polycarbonate, un polyétherimide, un polyamide, une polysulfone, une polyéthersulfone, une polyéthercétone, une polyétheréthercétone, une polyéthercétonecétone, un poly(oxyde de phénylène), un poly(sulfure de phénylène), et des mélanges de deux de ces matières plastiques synthétiques ou plus.

11. Matériau sandwich analogue à une feuille selon les revendications 3 à 10, dans lequel la résine thermoplastique synthétique injectée contient des fibres.

12. Matériau sandwich analogue à une feuille selon la revendication 11, dans lequel les fibres ont été choisies dans le groupe consistant en les fibres de verre, les fibres de polyamide comme les fibres d'aramide, les fibres de polyéthylène, les fibres de polyester et les fibres de carbone.

13. Matériau sandwich analogue à une feuille selon les revendications 1 à 12, comprenant en outre un dispositif auxiliaire monté dans le renforcement.

14. Matériau sandwich analogue à une feuille selon la revendication 13, dans lequel le dispositif auxiliaire a été monté pendant l'injection de la matière plastique.

15. Matériau sandwich analogue à une feuille selon les revendications 1 à 14, dans lequel un dispositif auxiliaire a été monté à l'endroit du renforcement après que le renforcement a été installé.

16. Matériau sandwich analogue à une feuille selon les revendications 13 à 15, dans lequel le dispositif auxiliaire est un dispositif de préhension, un élément constitutif ou un produit.

17. Matériau sandwich analogue à une feuille selon les revendications 13 à 16, dans lequel le dispositif auxiliaire est prévu et installé à l'endroit du renforcement par moulage par injection.

18. Procédé de production d'un renforcement local dans un matériau analogue à une feuille, comprenant un matériau formant âme situé entre deux couches supérieures renforcées, lequel matériau formant âme est un matériau formant âme thermoplastique mis sous forme de mousse ou un matériau formant âme ayant une structure en nid d'abeilles, et lesquelles couches supérieures consistent en une matière

plastique synthétique thermoplastique renforcée par des fibres, de préférence sous forme d'une étoffe tissée, d'une étoffe tricotée, d'une nappe fibreuse ou de fibres appliquées de manière unidirectionnelle, qui comprend l'injection d'une quantité de matière plastique sous pression dans le matériau formant âme à travers l'une des couches supérieures, laquelle matière plastique durcit après l'injection.

19. Procédé selon la revendication 18, dans lequel la matière plastique remplace et/ou fait fondre le matériau formant âme à l'endroit où elle est injectée.

20. Procédé selon la revendication 18 ou 19, dans lequel la matière plastique utilisée est une résine thermoplastique synthétique ayant une température de ramollissement d'au moins 50 °C.

21. Procédé selon les revendications 18 à 20, dans lequel la matière plastique est injectée sous pression à travers la couche supérieure renforcée dans l'âme à l'aide d'une machine de moulage par injection.

22. Procédé selon les revendications 18 à 21, dans lequel ledit matériau formant âme thermoplastique mis sous forme de mousse est un matériau choisi dans le groupe consistant en une mousse de polyétherimide, une mousse de polycarbonate, une mousse de polyméthacrylamide, une mousse de polyester, comme une mousse de PET ou de PBT, une mousse de polyéthersulfone, une mousse de polyéthercétone, une mousse de polyétheréthercétone, une mousse de polyéthercétonecétone, une mousse de poly(oxyde de phénylène), une mousse de poly(sulfure de phénylène) et un matériau en mous se formé de mélanges de résines thermoplastiques synthétiques contenant au moins l'une des résines thermoplastiques synthétiques citées.

23. Procédé selon les revendications 18 à 22, dans lequel le matériau formant âme thermoplastique mis sous forme de mousse contient des fibres.

24. Procédé selon la revendication 23, dans lequel les fibres sont choisies dans le groupe consistant en les fibres de verre, les fibres de polyamide, comme les fibres d'aramide, les fibres de polyéthylène, les fibres de polyester et les fibres de carbone.

25. Procédé selon les revendications 18 à 24, dans lequel le matériau formant âme thermoplastique mis sous forme de mousse contient des matériaux cristallins liquides.

26. Procédé selon les revendications 18 à 25, dans lequel la résine thermoplastique synthétique de la couche supérieure est choisie dans le groupe consistant en un polyester comme PET et PBT, un polycarbonate, un polyétherimide, un polyamide, une polysulfone, une polyéthersulfone, une polyéthercétone une polyétheréthercétone, une polyéthercétonecétone, un poly(oxyde de phénylène), un poly(sulfure de phénylène), et des mélanges de deux de ces matières plastiques ou plus.

27. Procédé selon les revendications 18 à 26, dans lequel la matière du renforcement dans la couche supérieure est choisie dans le groupe consistant en les fibres de verre, les fibres de polyamide comme les fibres d'aramide, les fibres de polyéthylène, les fibres de polyester et les fibres de carbone.

28. Procédé selon les revendications 20 à 27, dans lequel la résine thermoplastique synthétique qui doit être injectée est choisie dans le groupe consistant en le polystyrène, les polymères du styrène, les polymères d'acrylate et/ou de méthacrylate, les polyoléfines, les polyesters comme PET et PBT, un polycarbonate, un polyétherimide, un polyamide, une polysulfone, une polyéthersulfone, une polyéthercétone, une polyétheréthercétone, une polyéthercétonecétone, un poly(oxyde de phénylène), un poly(sulfure de phénylène), et des mélanges de deux de ces matières plastiques ou plus.

29. Procédé selon les revendications 20 à 28, dans lequel la résine thermoplastique synthétique qui doit être injectée contient des fibres.

30. Procédé selon la revendication 29, dans lequel les fibres sont choisies dans le groupe consistant en les fibres de verre, les fibres de polyamide comme les fibres d'aramide, les fibres de polyéthylène, les fibres de polyester et les fibres de carbone.

31. Procédé selon les revendications 18 à 30, dans lequel un dispositif auxiliaire est monté dans le renforcement.

32. Procédé selon la revendication 31, dans lequel le dispositif auxiliaire est monté pendant l'injection de la matière plastique.

33. Procédé selon les revendications 18 à 32, dans lequel un dispositif auxiliaire est monté à l'endroit du renforcement après que le renforcement a été installé.

34. Procédé selon les revendications 30 à 33, dans lequel le dispositif auxiliaire est prévu et installé à l'endroit du renforcement par moulage par injection.

35. Procédé selon les revendications 30 à 34, dans lequel le dispositif auxiliaire est un dispositif de préhension, un élément constitutif ou un produit.